Evaluation of Online Instructional Model for Teaching Hands-On Technical Skills

Nguyen Thi Huong GIANG
Hanoi University of Science and Technology, Hanoi, Vietnam
giang.nguyenthihuong@hust.edu.vn

ABSTRACT

Purpose
The authors' study is about proposing, implementing and evaluating a model for online technical skills instruction.
Design/Methodology
The author's methodology is about creating an online environment adapted to the instruction of technical skills, applying it to the process of teaching the making of a network cable, and evaluating the effectiveness of our online method through a survey comparing it with face-to-face teaching.
Findings
The paper compares the online training with face-to-face teaching using the following criteria:

- *The presentation of learning content*
- *The positive learning of students*
- *Students' completion of the skills*
- *The effectiveness of online learning*
- *The organisational capability of online courses*
- *The requirement of IT skills for online teachers*

Conclusion
The research of this paper aims to prove the effectiveness of the presentation of learning content, the capability to support students to learn and to practise technical skills in online courses.
Value
This paper introduces the interesting three-stage approach and solutions for teaching hands-on technical skills online.

Keywords: *online learning, e-learning, instructional model, technical skills, online teaching technology.*

INTRODUCTION

Online learning has been developed since the late 1990s (Mallon, Bersin, Howard, & O'Leonard, 2010), and has continued to make advances in developed countries. However, the application of online learning in Vietnam's education system is substandard, and is just focused on sharing knowledge. The instructional strategies for online courses in Vietnam have been poorly designed for the teaching of

technical skills. Therefore, the main purpose of this paper is to study the online instructional technology for teaching and learning technical skills.

Formation of technical skills

The purpose of teaching technical skills is to help students gain knowledge relating to these skills and practices. The methods of teaching for forming technical skills are that students observe the teacher's actions and then practise them following the teacher's guidance. The building of technical skills occurs according to certain rules (Tuan, 2009), which start at the student's level of perception and end with performing concrete actions. This process consists of three phases as follows:

(1) Forming motivation and perceiving necessary knowledge for actions;
(2) Analysing movement of actions;
(3) Performing actions.

The results of the first phase are the symbol and image of action, in which students must understand the purpose, tasks and the principles of actions. In order to achieve this outcome, the teacher should motivate and support the student in the necessary knowledge relating to the skills.

In the second phase, students will form their physical movement by observing and imitating in sense the model performer. To support the leaner, teachers need to lead by example and carefully explain the techniques in terms of acquiring the skills.

In the third phase, skills are formed gradually during the process of repeated physical movements. Therefore, in this phase teachers should provide practice opportunities for students.

The above three-phase process is a basis to design lesson plans of instructing technical skills as well as the requirement of building an online environment for teaching technical skills.

Online instructional technology

Online learning (or online learning and teaching) is the instructional form that integrates ICT applications to deliver lessons to learners via the Internet.

Instructional technology is the process of using a system of teaching methods, media and skills cumulatively and creatively in order to take advantage of objective rules (science) to influence learners and help them achieve the qualifications necessary to meet the employment needs of the society (Lac, 2009). As a result, we propose the definition of online instructional technology as follows:

Online instructional technology is the online teaching and learning process aimed at helping students achieve the necessary qualifications (including working knowledge, skills and behaviour) in order to meet the employment needs of the society.

Thus, online learning is a technological approach (Lac, 2012), which consists of inputs (learners), objectives, lesson content, teaching technologies and performance evaluation. This process is always based on the criteria of feasibility (i.e. learning and teaching capabilities) and effectiveness (i.e. good learning and teaching) of designing, building and testing the learning process. The former is done using the relevant media and methods, and the latter is achieved by the skills (including advice) of the creator and his using of methods and means. As a result, it is very important to use and create the teaching media in the online teaching process.

The online teaching media given here is usually understood as a model to simulate the science and technical subjects. In general, the model is understood as an instance of the entity or the concept – a number of attributes and typical relations of a certain object (called "prototype") for the purpose of awareness such as the observed object (to identify) instead of the prototype, and/or the research object (to experiment or interpretation) about the prototype. Therefore, some kinds of models are as follows:

- Entity model (physical model)
    - Sampling model
    - Uniform model
    - Same model
- Conceptual model
    - Iconic model
    - Mathematical model
    - Idea model

Performing an object by the corresponding model is called modelling. The theory of modelling is the theoretical basic of building a model and is defined thus:

- Model satisfies the requirements of the problem considering the prototype that determines the eligibility of the model.
- The transformation from the results of researching the model to the corresponding results of researching the prototype.

As a result, the process of teaching technical skills online is the problem of using and creating the online teaching means in the dialectical relationship with the online teaching methods and the online teaching skills to help the learner to form the physical skills according to the profession's requirements.

METHODOLOGY

Creating an online environment adaptable with the instruction of technical skills

In the process of teaching technical skills, the online teaching methods are integrated into specific teaching strategies to gain the learning outcomes. This integration is proposed in Figure 1.

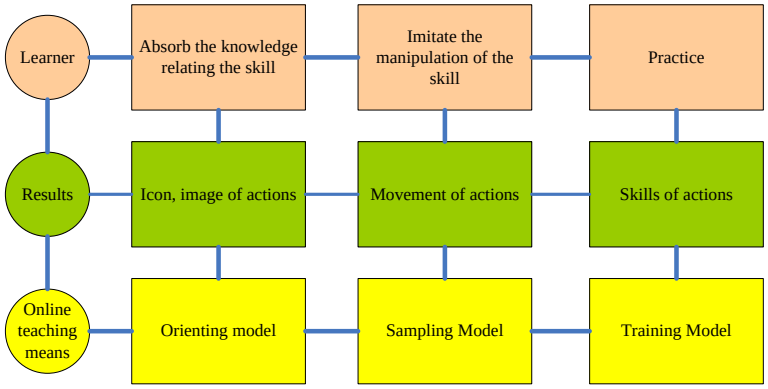

Figure 1: Online instructional model for forming technical skills

The purpose of the orienting model is to help the learner understand how to perform the skills. By this model, the learners will have a clear knowledge and understanding of the key concepts relating to these skills. Thus, the orienting model is a technical solution to design the interactive multimedia by which learners can attain the necessary knowledge.

The sampling model is a model analysing the principles of movement. The model will support the learners with information regarding the mechanics of performance such as preparation, action when applying skills and techniques, skills and techniques necessary for efficient and effective movement. The most important attribute of the sampling model is the awareness of the model performer.

The training model must integrate the online teaching means with the most relevant methods of practice. At the stage of practice, learners develop their skills or techniques according to guidance from the teacher.

Applying the model to the process of teaching the making of a network cable

The process of teaching this online course is on the website http://spkt-bkhn.edu.vn/moodle. The course "How to make a network cable" is divided into three stages as described in Figure 2.

Figure 2: Organisation of online course in three stages

The first stage: Supporting necessary knowledge relating the skills

The main purpose of this stage is to help online learners know how to arrange the coloured wires in UTP cable under standard T568A/B. Thus, the learning content in this phase includes the theory of making the network cable, structure of the UTP cable and method of arranging coloured wires in the cable. Strategies for designing the orienting model are concentrated into simulating the manipulation of this arrangement.

According to the theory of instructional technology, this orienting model is the **same model as a set of coloured wires in UTP cable (prototype)**. This model conforms to the requirements of a conceptual model. The practical process in the orienting model helps learners to form the thinking skills about the correct order of coloured wires. On the model, the learners can arrange the coloured wires using trial and error and repeating the trials until they learn the correct order by heart.

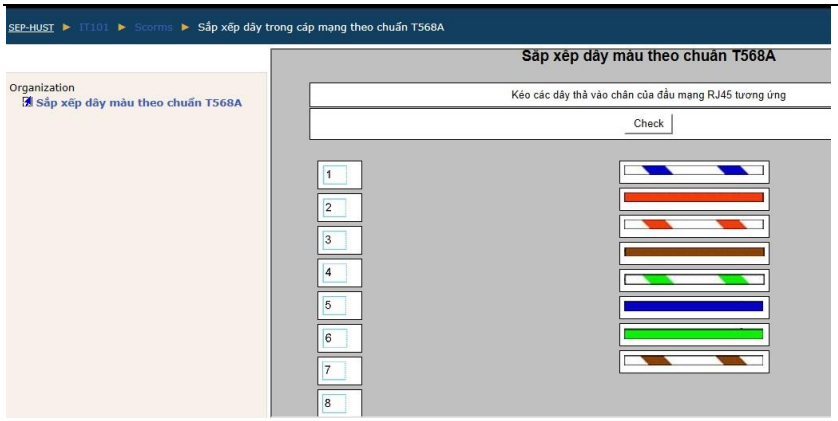

Figure 3: Orienting model - simulation of arranging coloured wires in UTP network cable according to the standard T568A

The feasibility and effectiveness of this model include the capability of exploiting the strengths of common software (such as Hot Potatoes, Course Lab) in implementing the visual test in which the learners can drag and drop the corresponding coloured wires in the given order. Using this model in teaching technical skills can overcome the weakness of face-to-face teaching (for example, waste of time when teaching theory in class) as well as the limitation of trial numbers because of the cost of materials. In particular, the trial and error method allows learners to manipulate the number of unrestricted factors (in this case there are eight coloured wires) that helps to open up a cost-effective solution for teaching technical skills online.

Moreover, the orienting model is fully observational and controllable because the model can notify if positions are arranged incorrectly and require the learners to re-arrange them correctly. The capability of feedback and the unrestricted number of trials improve the interactive attributes of this model.

The second stage: Imitating the movement of the actions

This is the formative stage of movement helping the learners mimic the actions of the model performer. Here, the construction of the **sampling model** is the modelling video. The principles to build a modelling video include:

- Making a storyboard for each model step;
- Organising the scene and making the video;
- Editing and processing the video;
- Making the learning package and uploading it into the LMS.

Although it takes a lot of time to make a modelling video, the learners are effectively supported by the teaching strategies thus:

- Observation of the model performer is easier (although the coloured wires in UTP cable are relatively small).
- The steps of instruction are clearly divided and easy to remember. Importantly, if learners are unsure about any manipulation, they can watch the sample video again.
- In each step, the knowledge test can be inserted to help learners remember the key steps.

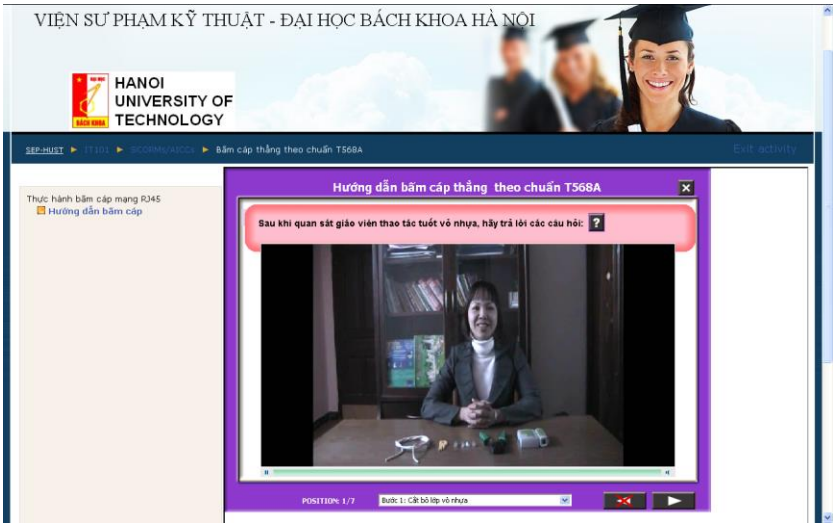

Figure 4: Sampling model of skill performance

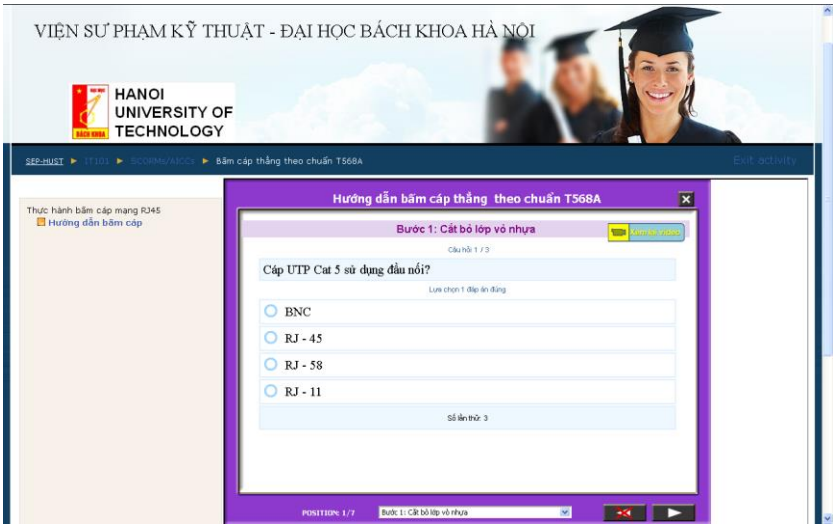

Figure 5: Knowledge test in each step

As a result, in the process of teaching technical skills online, the instructional strategies are integrated into the modelling video that improves the effectiveness of the process of imitation.

The third stage: practices to form skills

This stage requires the technology to meet special conditions, such as the need for supervision by teachers during practice time, and to help learners when they need it. Therefore, this stage must use the online teaching media that can support synchronous interactions between teachers and learners. In Moodle LMS, this requirement can be done by extra installation of BigBlueButton software in the Activities module that can create a virtual classroom. BigBlueButton supports this ability as follows:

- Webcam: many learners can share their Webcam at the same time; there is no limitation on the number of cameras
- Presentation: the performer can upload pdf files and office documents to present, and thus keep everyone in sync with his/her current performance;
- VoIP: support voice over IP. Students need to have a microphone and speakers to take part in the online classroom.
- Desktop sharing: Teachers can share their computer screens with all the learners.

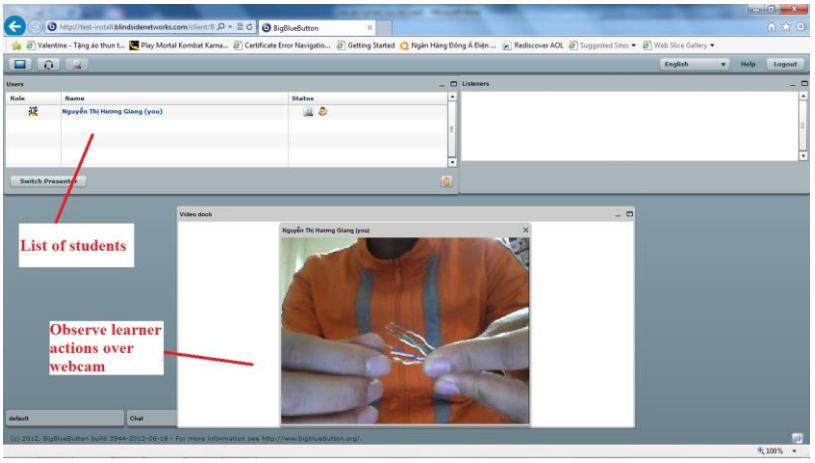

Figure 6: Training model: virtual classroom using BigBlueButton installed in Moodle

By using BigBlueButton, the learning environment becomes an online classroom where learners and teachers can directly interact with each other during the process of practising the skills of network cable making.

Evaluating the effectiveness of the online course "How to make a network cable"

The online course "How to make a network cable" designed and published on the website http://spkt-bkhn.edu.vn/moodle was trialled in the Hanoi School of Mechanics I (Tan, 2012). The surveys were done to evaluate the effectiveness of the online teaching by questioning students and colleagues.

There were 40 students participating in the surveys. They were divided into two groups, each with 20 students. The first group underwent face-to-face training, while the other experienced the online model. Ms Tan, the teacher of this School, taught both groups how to make a network cable.

At the end of the training process, students were asked to evaluate three aspects:

i) Presentation of learning content
- Comprehensive delivery of the learning content
- Clear presentation of the learning content
- Supporting the learning facilities (e.g. researching, document downloading and uploading)
- Supporting the interactive facilities (e.g. forums, chat room, social networking)
- Simulating and doing virtual experiments

ii) Positive learning of students
- Reading the learning materials required
- Reading the references
- Talking to other students about related learning contents
- Doing exercises
- Regularly practising the technical skills

iii) Completion of the skills of students.

The second survey was undertaken of other academic staff about the efficacy of using online learning in teaching technical skills. Fourteen colleagues observed the online classroom. At the end of the survey, the colleagues were asked about:
- Frequency of attendance of learners in online courses
- Effectiveness of the online learning
- Level of organisation required to conduct online courses
- Level of IT skill requirements for teachers.

RESULTS AND DISCUSSION

The first survey: students participating in the courses

The results of surveys about the presentation of learning content are described in Table 1, which proves the capability of applying the online models in learning and teaching.

Table 1: Presentation of learning content

Criteria	Face-to-face training		Online training	
	Number of students (Max. of 20)	Percentage (%)	Number of students (Max. of 20)	Percentage (%)
Comprehensive delivery of the learning content	12	60	17	85
Clear presentation of the learning content	7	35	15	75
Supporting the learning facilities (e.g. research, download, upload documents)	3	15	20	100
Supporting the interactive facilities (e.g. forums, chat rooms, social networking)	0	0	20	100
Simulating and doing virtual experiments	0	0	20	100

In general, in face-to-face training, presentation of learning content is not good. Specifically, it is not supported with interactive facilities, simulation and virtual experiments. The capability of delivering learning content is not high (60%) and the aesthetics of learning content is weak (35%). The capacity for data research, downloading and uploading is limited (15%). In contrast, the presentation of online learning content is evaluated well. There are always online facilities supporting the learning material. The learning content is delivered comprehensively (85%) and clearly presented (75%).

The survey results in Table 2 also prove that the online courses can help students to learn more effectively.

Table 2: Positive learning of students

Learning actions	Face-to-face training		Online training	
	Number of students (Max. of 20)	Percentage (%)	Number of students (Max. of 20)	Percentage (%)
Reading the learning materials required	3	15	15	75
Reading the references	1	5	13	65
Talking to other students about related learning content	2	10	14	70
Doing exercises	2	10	15	75
Regularly practising the technical skills	5	25	20	100

Learning actions in the face-to-face training model are more limited than in the online model. Students read the required learning materials in the face-to-face classroom less than in the online course (15% and 75%, respectively), and the percentage who study the reference materials in the former is lower than in the latter (5% and 65%, respectively). In the online courses, the interaction among students is better than in the face-to-face ones (70% and 10%, respectively). Moreover, online students engage more with the exercises (75%) and practise technical skills more regularly (100%).

In this survey, at the end of the trial lesson, the ratio of students in the online model able to make a network cable were 20/20, while in the face-to-face model, the ratio was only 15/20.

The second survey: asking colleagues observing the lesson
The results of this survey in Table 3 show the opinion of teachers about applying the online learning model in teaching technical skills.

Table 3: Opinion of teachers about teaching technical skills online

Opinions	**Number of teachers (Max. of 14)**	**Percentage (%)**
Frequency of attendance of learners in online courses	12	85.71
Effectiveness of the online learning	14	100
Level of organisation of online course	8	57.14
Level of IT skills for online teachers	14	100

The application of the online model to teach technical skills has various advantages. 85.71 % of the observing teachers agree that online students are more active, and they also highly assess the effectiveness of the online model. Nearly 50% of the teachers, however, contend that it is difficult to know how students learn in an online course. Besides, they maintain that the IT skills of all teachers need to be upgraded to meet online teaching requirements.

CONCLUSION

In summary, the three-stage approach introduced in the online model increasingly proves its feasibility in the real learning and teaching of technical skills. The results of online courses show the effectiveness of the presentation of learning content, and that is has the capability of supporting students to learn and to practise technical skills. Moreover, the ICT application in online courses helps the students to communicate with each other more easily and create an active learning network. As a result, the proposals in this paper will enrich the teaching models of technical skills and enlarge the online learning network.

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